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ABSTRACT

This autoinstructional program deals with the use of thermometers as related to the physical sciences. It is suggested for use in Middle School science programs. A student is required to have a knowledge of the metric system and be familiar with Fahrenheit, Celsius and Kelvin scales. Behavioral objectives are included as well as equipment needed, time allotment (50 minutes), and reference to "Interaction of Matter and Energy," Rand McNally - 1968 as cited bibliographical data. Instructions are presented with a question sheet to be completed by the student. (EB)

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CALIBRATING A THERMOMETER

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TEACHER'S GUIDE

PACKER NUMBER

542
B

SUBJECT

Physical Science

TITLE

Calibrating A Thermometer

LEVEL

Middle School

PREREQUISITES

Knowledge of the Metric System
Introduction to Fahrenheit, Celsius and Kelvin scales.

BEHAVIORAL OBJECTIVES

At the completion of this mini lesson, the student:

1. Will have compared the following points of three temperature scales - Fahrenheit, Celsius, and Kelvin.

   a. boiling point
   b. freezing point
   c. room temperature
   d. body temperature

2. Will have constructed Fahrenheit and Celsius scales on a glass rod to make a thermometer.

EQUIPMENT

Uncalibrated alcohol thermometer
Plastic metric ruler
Masking tape
Beaker of crushed ice
Water bath
Bunsen burner
5" x 8" index card
Encyclopedia
Script
Cassette tape and recorder

TIME

50 minutes

BIBLIOGRAPHY

Interaction of Matter and Energy; Abraham et al., Rand McNally; 1968 N.Y.

SCRIPT

PHYSICAL SCIENCE
CALIBRATING A THERMOMETER

A thermometer is useful for measuring changes in temperature. Thermometers can also reveal information about relationships between matter and energy. There are many kinds of thermometers. You will be using an alcohol thermometer. The thermometers doctors use to measure body heat contain mercury instead of alcohol. When the temperature of liquids such as alcohol or mercury is increased their volumes increase. When a given amount of such a liquid is confined within a tube, an increase in volume results in a longer column of liquid. Therefore, the longer a column of alcohol or mercury, the higher the temperature. Lower temperatures are indicated by a decrease in length of the liquid column.

Your first task will be to calibrate temperatures on an alcohol tube. When you calibrate this tube, you will use it to investigate certain properties of matter that involve both chemical and physical interactions. (Pause)

Take the 5" x 8" index card at your table and tape the glass tube to the card. Be sure to tape the top only so the bottom of the tube is free to dip in water. Also, make a mark at the bottom of the tube. If you remove the tube for any reason, you will be able to replace it exactly as before.

Stop the recorder and complete this portion of the assignment. After you have finished, compare your card to picture 1. (Pause)

PHYSICAL SCIENCE
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Place the glass tube in the water bath and heat the water until it boils. Remove the tube and mark the card where the red liquid has reached. Use the left side of the card for Fahrenheit and the right side for Celsius. This mark represents 212°F. and 100° C. Turn off the bunsen burner when you finish. Stop the recorder. (Pause)

Look at picture II and compare your card with the picture. (Pause)

Allow the thermometer to cool. Then, immerse the tube for several minutes in a beaker half-filled with crushed ice. When the length of the alcohol column no longer changes, mark the card on both sides of the tube. This mark represents 32°F. and 0°C. Record these numbers on your card. Stop the recorder. (Pause)

At this time you have two points plotted on each side of the glass tube. (Freezing point and boiling point) What are some of the other temperatures that you know that could also be marked on your card? Stop the recorder and attempt to mark additional temperatures. (Pause)

Have you marked room temperature? The tube has returned to room temperature since you removed it from the ice. Check the temperature in the room with the thermostat located on the wall. Mark the card and record the temperature on the card. Stop the recorder. (Pause)

Refer to picture III and see how this compared with your calibrations. (Pause)

PHYSICAL SCIENCE
CALIBRATING A THERMOMETER

At this point, you can calibrate other points on the card with use of the metric ruler provided at your station. Measure the distance between the freezing point and the boiling point. In Celsius the halfway point will be 50°. With this method, find 75°C, 25°C, -25°, -50°C, -75°C and -100°C.

Stop the recorder. (Pause)

Attempt to do the same on the Fahrenheit side of the card. Make enough calibrations to make your thermometer useful. Stop the recorder. (Pause)

You have now made a glass rod into a useful thermometer.

QUESTION SHEET

PHYSICAL SCIENCE
CALIBRATING A THERMOMETER

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Answer the questions on this sheet and hand them in to your teacher when you have finished.

1. Dip your calibrated thermometer in a beaker of tap water.
   Record the temperature. _____ ^{o}F _____ ^{o}C
   Ask your teacher for a mercury thermometer and put it in your tap water. Record the temperatures in: _____ ^{o}F _____ ^{o}C

2. Which calibrations do you find easiest to complete? _____.

3. Using the reference book at your station, look up the Kelvin scale. Compare this scale with the two you have already completed. What is the freezing point and boiling point in Kelvin?

   _____ _____.

4. Don't be upset if your readings in number 1. do not compare with the mercury thermometer. List a few reasons why there might be a difference.
   a.
   b.
   c.
   d.